PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventor: STANLEY CRAIG

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COMPLETE SPECIFICATION

Improvements in or relating to Low Pressure or Vacuum Gauges

I, MINISTER OF SUPPLY, London, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to low pressure or vacuum gauges and especially to those known as Pirani gauges which take advantage of the fact that at low pressures the heat conductivity of a gaseous medium varies with the pressure and in which a hot filament affords a response to such change in heat conductivity. The upper limit of the pressure range over which such gauges are useful is limited so that it is currently the practice to use an additional gauge of different type where a useful response extending to pressures in excess of say 10 millimeters, or exceptionally above about 30 millimeters of mercury is required.

It has been found that, although the response of a hot filament at pressures below about 0.5 millimeters of mercury is not appreciably affected by movement of a gaseous medium relative to the hot filament or other element, such movement substantially increases the response at greater pressures and so increases the sensitivity at pressures above the upper pressure limit for a useful response without such movement, as to enable a useful response to be obtained up to at least atmospheric pressure (760 millimeters of mercury).

The present invention takes advantage of this, and in a wide range low pressure and vacuum gauge according to the invention there is relative motion between a gaseous medium whose pressure is to be indicated and a hot filament responsive to the change with pressure of heat conductivity of said medium whereby a useful response is afforded at pressures substantially greater than the maximum at which a useful response is obtainable without such relative motion.

The relative motion between the gaseous medium and the filament responsive to changes of its conductivity may be effected in various ways. The filament may be mounted on a rotary or vibratory carrier in a vessel for containing gaseous media whose pressure is to be indicated or, with or without provision for imparting motion to it, in a passage having provision for passing gaseous media through it.

No matter how the relative motion is effected, however, the sensitivity of the filament increases with the velocity of the relative motion for pressures above about 0.5 millimeters of mercury below which the sensitivity is practically independent of said velocity.

A preferred form of gauge head according to the invention involving neither slip rings to convey heating current to an electrically heated filament nor any need for motion of the gaseous medium, comprises a vessel having a flexible wall through which extends fluid-tight an arm carrying the filament and serving to convey heating current to the latter (*e.g.* the arm may be hollow and contain the leads), and motor means co-operating with the outer part of the arm to impart motion thereto. For example, the outer end of the arm may be caused to transverse a circular path such that the external and internal portions of the arm generate conical surfaces whose apices meet at the point where the arm penetrates the diaphragm.

Preferably, the filament is electrically heated and is connected in a self-balancing bridge circuit arrangement which acts automatically to tend to keep the resistance and so the temperature of the filament constant with pressure change and provision is made for indicating as a function of the pressure the energy supplied to the element.

Pirani gauge apparatus in accordance with one form of the invention is illustrated by the accompanying diagram which is diagrammatic and not to scale.

As shown, a hollow cylindrical mounting 11 formed with side openings 12, 12 is received at one end to a receptacle 13 for gaseous media whose pressure is to be indicated or measured and at its other end to a small electric motor 14. The adjacent wall of the receptacle 13 is apertured and has a central bush 15 through which extends an arm 16 that is uni-

versally pivotted intermediately of its length as indicated at 17 within the bush 15.

Near its outer (right hand as shown) end the arm 16 carries a disc 18 which closes airtight the corresponding end of a metal bellows 19 whose other end is secured air tight around the bush 15 so that said bellows 19 and disc 18 constitute a flexible airtight extension of the receptacle 13 permitting movement of the arm 16 about the universal pivot 17. The extreme outer end of the arm 16 is received in a small ball bearing 20 housed in a crank member 21 on the shaft of the motor 14.

At its inner (left hand as shown) end the arm 16 carries a helical filament 22 whose ends are connected by light bowed or hairpin spring conductors 23, 23 to insulated connectors 24, 24 extending through the wall of the receptacle 13 and which are accessible through the side openings 12, 12 in the cylindrical mounting 11.

In use, the filament 22 is heated by passing an electric current through it and the motor 14 drives the arm 16 on its universal pivot 17 so that its inner end and the filament 22 follow circular paths through the gaseous medium in the receptacle 13. Any known or convenient means, automatic or otherwise may be employed for indicating the response of the hot filament 22 to change of pressure in the receptacle 13. Preferably, the filament 22 is connected in a self-balancing bridge circuit arrangement which operates automatically to tend to keep the resistance and so the temperature of the filament 22 constant with pressure change and provision is made for indicating as a function of gas pressure in the receptacle 13 the energy supplied to the filament 22 for this purpose. Alternatively, however, either the voltage across, or the current in, the filament 22 may be maintained constant with gas pressure change and the current in, or resistance of, the filament 22 observed as a function of pressure in the receptacle 13.

WHAT I CLAIM IS:—

1. Pirani gauge apparatus in which there is relative motion between a gaseous medium whose pressure is to be measured or indicated and a hot filament responsive to the change with pressure of heat conductivity of said medium whereby a useful response is afforded at pressures substantially greater than the maximum at which a useful response is afforded without such relative motion.

2. Pirani gauge apparatus as claimed in claim 1, wherein the filament is mounted on a rotary or vibratory carrier in a receptacle for gaseous media where pressure is to be measured or indicated.

3. Pirani gauge apparatus as claimed in claim 2, wherein the receptacle has a flexible wall or extension through which an arm carrying the filament at its inner end extends to motor means for importing motion thereto.

4. Pirani gauge apparatus as claimed in claim 3, wherein the arm extends through a metal bellows within which it is supported on a universal mounting intermediately of its length and co-operates at its outer end with a crank whereby its ends are caused to traverse circular paths.

5. Pirani gauge apparatus substantially as hereinbefore described with reference to the accompanying diagrammatic drawing.

A. L. BING,
Chartered Patent Agent,
Agent for the Applicant.

PROVISIONAL SPECIFICATION

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It has been found that, although the response of a hot filament at pressures below about 0.5 millimeters of mercury is not appreciably affected by movement of a gaseous medium relative to the hot filament or other element, such movement substantially increases the response at greater pressures and so increases the sensitivity at pressures above the upper pressure limit for a useful response without such movement, as to enable a useful response to be obtained up to at least atmospheric pressure (760 millimeters of mercury).

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The relative motion between the gaseous medium and the filament or other element responsive to changes of its conductivity may

be effected in various ways. The responsive element may be mounted on a rotary or vibratory carrier in a vessel for containing gaseous media whose pressure is to be indicated or, with or without providing for imparting motion to it, in a passage having provision for passing gaseous media through it.

No matter how the relative motion is effected, however, the sensitivity of the responsive element increases with the velocity of the relative motion for pressures above about 0.5 millimeteres of mercury below which the sensitivity is practically independent of said velocity.

A preferred form of gauge head according to the invention involving neither slip rings to convey heating current to an electrically heated responsive element nor any need for motion of the gaseous medium, comprises a vessel having a flexible wall through which extends fluid-tight an arm carrying the responsive element and serving to convey heating current to the latter (*e.g.* the arm may be hollow and contain the leads), and motor means co-operating with the outer part of the arm to impart motion thereto. For example, the outer end of the arm may be caused to traverse a circular path such that the external and internal portions of the arm generate conical surfaces whose apices meet at the point where the arm penetrates the diaphragm.

Preferably, the responsive element is electrically heated and is connected in a self-balancing bridge circuit-servo arrangement which acts automatically to tend to keep the resistance and so the temperature of the responsive element constant with pressure change and provision is made for indicating as a function of the pressure the energy supplied to the element.

A. L. BING,
Chartered Patent Agent,
Agent for the Applicant.

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1 SHEET

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